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Article

Lifestyle habits and mental health in light of the two COVID-19 pandemic waves in Sweden, 2020

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Abstract: The COVID-19 pandemic has become a public health emergency of international concern, which may affect lifestyle habits and mental health. Based on national health profile assessments, this study investigates perceived changes of lifestyle habits in response to the COVID-19 pandemic and associations between perceived lifestyle changes and mental health in Swedish working adults. Among 5,599 individuals (50% women, 46.3 years), the majority reported no change (sitting 77%, daily physical activity 71%, exercise 69%, diet 87%, alcohol 90%, and smoking 97%) due to the pandemic. Changes were more pronounced during the first wave (April-June) compared to the second (October-December). Women, individuals <60 years, having a university degree, being white-collar workers and having unhealthy lifestyle habits at baseline had higher odds of changing lifestyle habits compared to their counterparts. Negative changes in lifestyle habits as well as more time in mentally passive sitting at home was associated with higher odds of mental ill-health (including health anxiety regarding one's own and relatives' health, generalized anxiety and depression symptoms, and concerns regarding employment and economy). The results emphasize the need to support healthy lifestyle habits to strengthen the resilience in vulnerable groups of individuals to future viral pandemics, and prevent health inequalities in society.

Keywords: Physical activity; Sitting; Alcohol; Diet; Smoking; SARS-CoV-2; Sweden; Mental health; Health anxiety; Depression

1. Introduction

The pandemic caused by the coronavirus (COVID-19) has become a global public health emergency. To stop the virus, confinement, social distancing and even full lock-down, have been implemented. Under such circumstances, there is a risk for radical changes of lifestyle habits such as physical activity (PA), sedentary behaviour, diet and alcohol consumption, which may impact mental health and other health outcomes.

During the pandemic, both lifestyle habits and mental health seem to have changed, but with mixed results from different studies. Regarding PA, studies from Belgium, France, and Switzerland have reported a general increase in both exercise frequency and sedentary behaviour [1, 2]. Conversely, in Italy, where more strict social restrictions

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were enforced, total PA decreased significantly during the first COVID-19 wave as compared to before, in all age-groups and especially in men [3]. Results from studies on change in diet, alcohol consumption, and smoking during home constraint are also conflicting. Several studies show small changes in dietary habits [4-6], while others report an increase in unhealthy food intake, over-eating, and snacking between meals [4, 7-9]. Similarly, studies indicate that alcohol consumption has not changed during home confinement [7, 10], while others report an increased alcohol consumption [9, 11, 12]. During the first wave of the COVID-19 pandemic, smoking was reported to both have increased [11, 13] and decreased [10, 14].

Associations between negative changes in lifestyle habits and an increased risk of depression, anxiety, and stress symptoms during the COVID-19 pandemic have been reported [11, 15]. At the same time, a positive association was found during the spring of 2020 between more time spent in moderate-to-vigorous PA and better mental health [3, 16, 17]. However, previous studies have investigated changes in lifestyle during COVID-19 in a relatively short perspective during the spring and summer of 2020. As the pandemic has continued, we need to examine longer-term effects on lifestyle and mental health including comparing differences between the different waves of the pandemic. Moreover, as governments have employed varying countermeasures and social restrictions, it is important to study the effects on lifestyle habits and health experiences in the context of different countries.

The main aim of the present study was therefore to investigate perceived changes in sitting, daily PA, exercise, diet, alcohol, and smoking in response to the twoCOVID-19 pandemic waves in Swedish working adults, and to study potential differences across age, sex, education, and occupational groups. An additional aim was to study the association between lifestyle changes and mental health in terms of health anxiety, generalized anxiety, and depressive symptoms.

2. Materials and Methods

Study population

Data originates from the Health Profile Assessment (HPA) database (http://www.hpihealth.se), which contains data from HPAs carried out in health services all around Sweden since the middle of the 1970s. An HPA includes a questionnaire about lifestyle and health experiences, measurements of anthropometrics and blood pressure, estimations of VO_2max from a submaximal cycle ergometer test, and a person-centred dialogue with an HPA coach. An HPA is offered to all employees working for a company or an organization connected to occupational or health related services, and is voluntary and free of charge for the employee. All data is subsequently recorded in the Health Profile Institute database. In the light of the COVID-19 pandemic emerging in March 2020, additional questions regarding working and commuting habits, perceived change in lifestyle habits, and mental health experiences in relation to the COVID-19 pandemic were added to the HPA in the middle/end of April. It was optional for the participants to answer the additional questions. The study includes and compares data from three periods: April to June, July to September and October to December, 2020. From the 21st of April 2020 to 2nd of December, a total of 5,599 men and women answered the additional COVID questions, and were included in the present analyses. For comparative purposes, an additional 6,232 men and women who performed a HPA during the same time period without answering the additional COVID-questions (Appendix, Table A1), as well as 20,864 men and women performing a HPA during the same time period in 2019 (Appendix, Table A2), were included. The study was approved by the ethics board at the Stockholm Ethics Review Board (Dnr 2020-02727). Informed consent was obtained from the participants prior to participation.

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Measures

The additional questions in relation to the COVID-19 pandemic are presented in Appendix A. They included questions regarding current working situation, commuting habits and perceived change in commuting habits, as well as perceived change in sitting, daily activity, exercise, diet, alcohol intake, and smoking due to the COVID-19 pandemic. Moreover, open questions regarding hours and minutes spent in a) mentally passive sitting, b) mentally active sitting, and c) socialization were included, as previous research have indicated different relationships between these different types of sedentary behaviour and mental well-being [18]. Finally, questions regarding health anxiety (SHAI) [19] one's own and relatives (modified from SHAI), employment [20] and economic [21] concerns, generalized anxiety [22], and depression [23] were included.

From the HPA, data on BMI and estimated VO_2max [24] were derived as well as self-reported baseline daily PA, exercise habits, sedentary behaviour, diet, alcohol abuse by AUDIT-C [25], smoking habits, overall stress, perceived health, and perceived symptoms of anxiety and depression (see Appendix B). Highest educational attainment at the time for the HPA was obtained from Statistics Sweden by linking of the participant's personal identity number. Occupation was reported by the participants and coded according to the Swedish Standard Classification of Occupation [26], and further dichotomized into blue- or white collar workers.

Statistical analyses

Chi-square test (percentages) or t-test (mean values) were used to compare participants with HPA + COVID-data and participants with only HPA-data during the study period (21st of April and 2nd of December 2020), as well as all participants with HPA-data during the study period and participants with HPA-data between the same dates in 2019. Differences in working situation, commuting habits, mental health and sitting time between subgroups (Table 1) were tested using Chi-square test (percentages) or t-test (mean values). Wave 1 of the COVID-19 pandemic was defined as 21st of April to 30th of June, and Wave 2 as 1st of October to 2nd of December, which corresponds to the two clear wave-shapes of hospitalization due to COVID-19 in Sweden according to the Public Health Agency of Sweden [27]. 1st of July to 30th of September was defined as months between the two waves with significantly lower incidence in COVID-19. Multinomial regression modelling was used to calculate odds ratios (ORs) with 95% confidence intervals (CIs) for self-reported perceived change in six different lifestyle habits due to the COVID-19 pandemic in association to sex (women vs. men), age-group (18-59 years vs. 60-78 years), educational level (University vs. non-university), occupation group (White collar vs. Blue collar), baseline level of each habit, and wave of COVID-19 compared to the summer months (April to June vs. July-Sept and October-December vs. July-Sept) (Table 2). Clustering of negative and positive perceived changes in lifestyle habits, respectively, were defined as negative or positive change in two or more lifestyle habits compared to less. Daily activity was not included in the clustered variable, as change in sitting and daily activity is interchangeably occurring (sitting less leads to more daily activity and vice versa). Moreover, OR and 95% CI was calculated using logistic regression modelling to study the association of dichotomized mental ill-health variables in relation to sex, age-group, educational level, occupation group, wave of COVID-19 pandemic (Table 4 above), type of sitting (Table 4 below) and perceived change in lifestyle habits (Figure 2). The mental health variables were dichotomized to describe mental ill-health according to the following: "Frequent health anxiety, own" (Question 7A in supplement figure 1, answer of reply 3 or 4 vs. 1); "Frequent health anxiety, relatives" (Question 7B, reply 3 or 4 vs. 1); "Frequent anxiety symptoms" (Question 10A, reply 3 or 4 vs. 1), "Frequent depression symptoms" (Question 10B, reply 3 or 4 vs. 1), "High concerns employment" (Question 8, reply 4 or 5 vs. 1); and "High concerns economy" (Question 9, reply 4 or 5 vs. 1). Significance level was set α<0.05. Data were analysed using SPSS (version 26), R 4.0.3 (R Core Team, 2020) with the Tidyverse library [28].

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3. Results

There were small, albeit statistically significant, differences between individuals answering (included in the present analyses) and not answering (excluded) the extra COVID-19 related questions Appendix Table A1). Compared to non-included individuals, included individuals (50% women, mean age 46.3 years) compromised more women, were older, had a higher educational level, were more often white-collar workers, had a lower BMI, exercised more, smoked less, but sat more at work and experienced more stress and symptoms of anxiety and depression. Moreover, when comparing individuals performing an HPA in year 2020 to 2019 (a "normal" year before COVID-19), we also noted some small but significant differences (Appendix table A2). Participants in 2020 were more likely to be women, older, exercised more and sat less, had a higher educational level, were more often white-collar workers, had better dietary habits, smoked less and experienced less stress, compared to HPA participants in 2019.

3.1 Working, commuting situation, and type of sitting at home

Almost half of the participants answering the additional COVID-19 questions reported that their occupation required that they stay at work (Table 1). The majority reported that they did not change their commuting habits due to the pandemic, whereas 10% reported that they had changed. Of those who changed, the greatest shift was from public transport to car (54%) and to active commuting (26%). Mean reported time spent in mentally active sitting was slightly higher compared to mentally passive sitting, with less time spent in sitting while socializing (131, 119 and 82 min/day). Men and blue-collar workers spent more time in mentally passive sitting, and less time in mentally active sitting, compared to women and white-collar workers. Participants <60 years spent more time in mentally active sitting than those ≥ 60 years.

Table 1. Working and commuting situation, and type of sitting at home during the study period

	Total	Men	Women	Difference sub-groups	18-59 yrs	60-78 yrs	Difference sub-groups	White-collar	Blue-collar	Difference sub-groups
Do you work from home?										
All the time	10%	10%	10%		10%	8%		12%	1%	
Partly	26%	27%	25%		27%	20%		30%	5%	
My occupation requires that I am at work	49%	47%	52%		48%	58%		41%	90%	
I can work at home, but chose to be at work	15%	17%	13%	p<0.001	15%	15%	p<0.001	18%	4%	p<0.001
How have your commuting habits to and from work changed due to the COVID-19 pandemic?										
Same as before	74%	75%	73%		74%	76%		70%	91%	
Changed	11%	9%	12%		10%	12%		12%	5%	
Stopped commuting	15%	16%	15%	p=0.004	16%	12%	p=0.010	18%	4%	p<0.001
If changed, how have they changed?										
Bus/train to active commuting	26%	21%	30%		26%	29%		26%	19%	
Bus/train to car	54%	57%	52%		55%	51%		55%	57%	
Car to active commuting	8%	12%	6%		8%	11%		9%	8%	

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Car to bus/train	2%	0%	3%		2%	1%		2%	0%	
Active commuting to car	8%	9%	8%		8%	7%		8%	11%	
Active commuting to bus/train	2%	1%	2%	p=0.009	2%	1%	p=0.930	1%	5%	p=0.232
Mentally passive sitting at home (min/day)	119 (78)	127 (82)	112 (73)	p<0.001	119 (77)	122 (84)	p=0.424	115 (74)	134 (87)	p<0.001
Mentally active sitting at home (min/day)	131 (174)	124 (167)	139 (179)	p=0.001	134 (177)	114 (143)	p=0.002	144 (182)	70 (107)	p<0.001
Sitting, socializing at home (min/day)	82 (68)	84 (68)	81 (68)	p=0.006	83 (69)	79 (62)	p=0.173	81 (64)	85 (83)	p=0.145

Data presented as percentage or mean (SD).

3.2 Perceived changes in lifestyle habits

Most individuals stated that they had not changed their lifestyle habits due to the COVID-19 pandemic; 77% reported no change in sitting, 71% no change in daily PA, 69% no change in exercise, 87% no change in diet, 97% no change in smoking and 90% no change in alcohol intake (Figure 1). For clustering of perceived change in lifestyle habits, 13% reported negative change in two or more lifestyle factors, whereas 8% reported a positive change in two or more lifestyle habits.

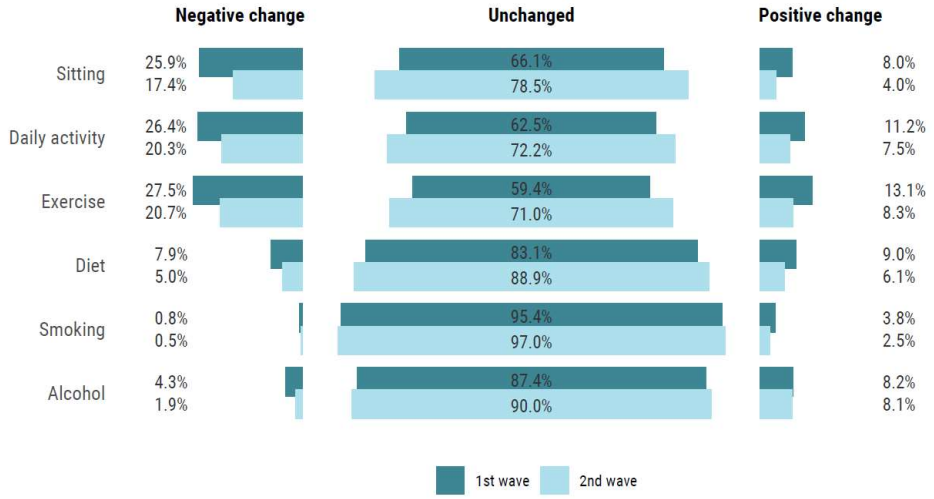

Figure 1. Self-reported change in lifestyle habits comparing wave 1 (April to June) and wave 2 (September to December).

Comparing the two waves, the odds for lifestyle changes, both negative and positive, were higher during the first wave compared to the second (Figure 1 and Table 2). For example, the odds of both a perceived positive and negative change in sitting time, daily PA and exercise were higher during the first wave compared to the second wave. Also, the odds were higher for a perceived negative change in diet and alcohol intake during the first wave compared to the second. Demographic factors were significantly associated with changes in lifestyle habits (Table 2). Women, younger participants (<60 years), participants with a university degree, white-collar workers and those with more adverse lifestyle habits had higher odds of changing their lifestyle due to COVID-19 pandemic.

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Table 2. Odds ratio (95% CI) for change in six different lifestyle habits in relation to sex, age-group, educational level, occupation group, baseline level of each habits as well as wave of COVID-19 (no change as reference)

	Negative change in lifestyle habits	**Positive change in lifestyle habits**
	OR (95% CI)	**OR (95% CI)**
Clustering of change in lifestyle habits§	Negative change in 2 or more vs. less	Positive change in 2 or more vs. less
Women vs. Men	1.25 (1.03-1.52)	1.12 (0.91-1.38)
18-59 yrs vs. 60-78 yrs	1.33 (0.97-1.83)	1.99 (1.34-2.95)
University vs. non-university	1.30 (1.07-1.58)	1.10 (0.89-1.36)
White collar vs. Blue collar	1.67 (1.21-2.30)	1.74 (1.25-2.43)
April-June vs. July-Sept	1.99 (1.55-2.55)	1.21 (0.94-1.56)
October-December vs. July-Sept	1.39 (1.11-1.75)	0.73 (0.58-0.93)
Sitting (n=4590)	Increased	Decreased
Women vs. Men	1.01 (0.86-1.19)	1.12 (0.84-1.48)
18-59 yrs vs. 60-78 yrs	1.36 (1.04-1.77)	0.92 (0.62-1.38)
University vs. non-university	1.61 (1.37-1.90)	1.17 (0.88-1.55)
White collar vs. Blue collar	1.75 (1.35-2.28)	2.44 (1.47-4.04)
Low/moderate vs. high leisure time sitting*	0.63 (0.49-0.80)	1.14 (0.69-1.89)
April-June vs. July-Sept	2.70 (2.20-3.32)	2.19 (1.58-3.04)
October-December vs. July-Sept	1.50 (1.24-1.82)	0.79 (0.56-1.10)
Daily activity (n=4576)	Decreased	Increased
Women vs. Men	1.38 (1.17-1.61)	1.06 (0.85-1.32)
18-59 yrs vs. 60-78 yrs	0.90 (0.71-1.12)	1.48 (1.02-2.15)
University vs. non-university	1.10 (0.93-1.29)	1.05 (0.84-1.31)
White collar vs. Blue collar	1.08 (0.86-1.36)	2.03 (1.41-2.91)
Low/moderate vs. high leisure time sitting*	0.65 (0.52-0.82)	1.72 (1.11-2.68)
April-June vs. July-Sept	2.19 (1.80-2.68)	1.47 (1.13-1.91)
October-December vs. July-Sept	1.45 (1.21-1.74)	0.74 (0.58-0.95)
Exercise (n=4591)	Decreased	Increased
Women vs. Men	1.36 (1.16-1.60)	1.03 (0.84-1.27)
18-59 yrs vs. 60-78 yrs	1.00 (0.79-1.25)	1.29 (0.91-1.83)
University vs. non-university	1.00 (0.85-1.18)	1.12(0.91-1.38)
White collar vs. Blue collar	1.16 (0.93-1.46)	1.93 (1.36-2.74)
≥3 times/week of exercise vs. less	0.65 (0.53-0.79)	4.38 (3.07-6.23)
1-2 times/week of exercise vs. less	1.67 (1.38-2.02)	2.46 (1.67-3.64)
April-June vs. July-Sept	2.39 (1.95-2.92)	1.38 (1.08-1.77)
October-December vs. July-Sept	1.50 (1.25-1.80)	0.67 (0.53-0.85)
Diet (n=4579)	Impaired	Improved

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Women vs. Men	1.17 (0.89-1.54)	1.16 (0.91-1.48)
18-59 yrs vs. 60-78 yrs	1.39 (0.88-2.21)	1.78 (1.15-2.76)
University vs. non-university	1.27 (0.97-1.67)	1.04 (0.81-1.33)
White collar vs. Blue collar	1.93 (1.22-3.06)	1.91 (1.27-2.86)
Good vs. poor diet#	0.19 (0.13-0.30)	1.12 (0.54-2.32)
April-June vs. July-Sept	2.02 (1.45-2.81)	1.27 (0.95-1.69)
October-December vs. July-Sept	1.08 (0.78-1.50)	0.71 (0.54-0.94)
Alcohol intake (n=5171)	Decreased	Increased
Women vs. Men	0.60 (0.41-0.86)	0.90 (0.72-1.13)
18-59 yrs vs. 60-78 yrs	1.99 (1.01-3.95)	2.65 (1.68-4.20)
University vs. non-university	1.07 (0.74-1.55)	1.04 (0.83-1.30)
White collar vs. Blue collar	1.24 (0.76-2.02)	1.04 (0.77-1.41)
April-June vs. July-Sept	1.93 (1.27-2.92)	1.18 (0.89-1.58)
October-December vs. July-Sept	0.85 (0.56-1.30)	1.14 (0.89-1.44)
Smoking (n=4505)	Decreased	Increased
Women vs. Men	1.28 (0.47-3.48)	1.42 (0.96-2.11)
18-59 yrs vs. 60-78 yrs	-	1.02 (0.58-1.81)
University vs. non-university	3.14 (1.03-9.53)	0.77 (0.50-1.19)
White collar vs. Blue collar	0.74 (0.23-2.42)	0.79 (0.48-1.28)
Never/Occasionally vs. Daily smoker	0.00 (0.00-0.01)	0.23(0.12-0.44)
Occasionally smoker vs. Daily smoker	0.19 (0.07-0.53)	1.53 (0.76-3.10)
April-June vs. July-Sept	2.47 (0.82-7.44)	1.44 (0.91-2.29)
October-December vs. July-Sept	1.32 (0.40-4.35)	1.09 (0.71-1.67)

Note: All analyses mutually adjusted for sex, age-group, educational level, occupational group, wave of COVID-19 and baseline values for each lifestyle habit (except for alcohol, see text and Appendix table A3). * HPA question regarding sitting in leisure, coded as Low/moderate = "Almost no time", "25% of time", "50% of time" and High="75% of time", "All the time". # HPA question regarding diet, coded as Good = "Very good" or "Good" and Poor = "Neither good or bad", "Poor", "Very poor". § Including change in sitting, exercise, diet, alcohol and smoking.

3.3 Mental health experiences

The majority of participants had low personal health anxiety, generalized anxiety and depression symptoms as well as concerns regarding their employment and economy, with a higher proportion experiencing health anxiety for relatives (Table 3).

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Table 3. Health experiences during the study period in the total population as well as in relation to sex, age and occupational group.

	Total	Men	Women	Difference sub-groups	18-59 yrs	60-78 yrs	Difference sub-groups	White-collar	Blue-collar	Difference sub-groups
Health anxiety, own										
I do not worry	46%	52%	41%		47%	45%		45%	52%	
I spend a lot/most of the time worrying	5%	4%	6%	p<0.001	5%	3%	p=0.010	5%	5%	p<0.001
Health anxiety, relatives										
I do not worry	22%	27%	16%		21%	25%		21%	25%	
I spend a lot/most of the time worrying	12%	8%	15%	p<0.001	12%	8%	p=0.002	12%	10%	p=0.006
Generalized anxiety										
Not at all	80%	85%	75%		80%	81%		80%	82%	
More than half of the days/Almost every day	4%	3%	5%	p<0.001	4%	4%	p=0.945	4%	3%	p=0.149
Depression symptoms										
Not at all	73%	80%	67%		73%	78%		73%	77%	
More than half of the days/Almost every day	4%	3%	5%	p<0.001	4%	3%	p=0.008	4%	4%	p=0.014
Concerns employment										
Not at all	75%	76%	74%		74%	83%		75%	71%	
Worry alot	5%	4%	5%	p=0.147	5%	4%	p<0.001	4%	6%	p=0.019
Concerns economy										
Not at all	65%	66%	63%		63%	76%		65%	64%	
Worry alot	6%	5%	7%	p=0.003	7%	4%	p<0.001	6%	6%	p=0.856

Six percent had clustering of two or more variables of mental ill-health (Table 4). In general, women and participants <60 years had higher odds of mental ill-health compared to men and participants ≥60 years (Table 4), while participants with a university degree and white-collar workers had significantly lower odds of having concerns regarding employment or economy (only university degree participants) compared to their counterparts. As for perceived change in lifestyle habits, the odds of mental ill-health were higher during the first wave compared to the second.

Table 4. Odds ratio (95% CI) for clustering of mental-ill health, as well as each individual mental ill-health variable, in relation to sex, age, occupational group, educational level and wave of COVID-19 pandemic (above) and time in sitting engaging in either mentally passive, mentally active or socializing activities (below).

	Clustered risk for mental ill-health, ≥2 vs. less*	Frequent health anxiety, own	Frequent health anxiety, relatives	Frequent anxiety symptoms	Frequent depression symptoms	High concerns employment	High concerns economy
Women vs Men	2.32 (1.70-3.17)	2.15 (1.50-3.07)	3.06 (2.44-3.84)	2.60 (1.87-3.63)	2.69 (1.94-3.72)	1.48 (1.11-1.97)	1.56 (1.21-2.00)
18-59 yrs vs. 60-78 yrs	1.94 (1.15-3.28)	2.17 (1.13-4.19)	1.90 (1.33-2.72)	1.12 (0.71-1.75)	1.83 (1.07-3.14)	1.50 (0.97-2.34)	1.88 (1.25-2.83)
University vs. non-university	0.82 (0.61-1.11)	1.30 (0.91-1.86)	0.87 (0.69-1.09)	0.73 (0.53-1.01)	0.89 (0.65-1.21)	0.68 (0.50-0.92)	0.64 (0.49-0.83)
White collar vs. Blue collar	0.94 (0.62-1.44)	0.67 (0.42-1.08)	0.93 (0.68-1.26)	1.05 (0.66-1.67)	0.74 (0.49-1.13)	0.69 (0.48-0.98)	0.93 (0.67-1.29)

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April-June vs. July-Sept	1.49 (1.03-2.16)	2.17 (1.42-3.34)	2.87 (2.16-3.81)	1.18 (0.79-1.78)	1.63 (1.11-2.40)	0.93 (0.64-1.33)	1.36 (0.99-1.86)
October-December vs. July-Sept	1.39 (0.99-1.93)	1.44 (0.97-2.13)	1.32 (1.04-1.69)	1.30 (0.93-1.81)	1.34 (0.96-1.89)	0.91 (0.67-1.22)	1.17 (0.89-1.54)
Perceived good health vs. poor health	0.11 (0.08-0.14)	0.02 (0.01-0.03)					
Time in mentally passive sitting							
T1; 0 to 90 min/day	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
T2; 90 to 120 min/day	0.89 (0.62-1.27)	1.36 (0.90-2.05)	1.51 (1.14-1.99)	1.05 (0.69-1.59)	0.89 (0.57-1.38)	1.24 (0.85-1.80)	1.44 (1.04-1.99)
T3; > 120 min day	1.59 (1.12-2.25)	1.82 (1.19-2.80)	2.00 (1.48-2.71)	1.62 (1.07-2.46)	1.67 (1.10-2.52)	1.77 (1.21-2.58)	2.09 (1.50-2.92)
Time in mentally active sitting							
T1; 0 to 30 min/day	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
T2; 30 to 90 min/day	0.98 (0.67-1.34)	1.06 (0.69-1.61)	1.09 (0.82-1.45)	1.10 (0.73-1.66)	0.88 (0.58-1.35)	0.93 (0.65-1.32)	0.83 (0.61-1.14)
T3; > 90 min/day	1.15 (0.82-1.60)	1.36 (0.91-2.04)	1.27 (0.96-1.67)	1.27 (0.85-1.89)	1.15 (0.78-1.71)	1.08 (0.76-1.54)	1.03 (0.76-1.40)
Time in sitting socializing							
T1; 0 to 60 min/day	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
T2; 60 to 90 min/day	0.93 (0.45-1.90)	1.13 (0.53-2.42)	0.93 (0.54-1.61)	0.72 (0.30-1.71)	0.73 (0.30-1.78)	0.70 (0.30-1.62)	0.68 (0.33-1.42)
T3; > 90 min/day	1.01 (0.75-1.36)	0.91 (0.64-1.29)	1.13 (0.89-1.43)	0.81 (0.56-1.17)	0.74 (0.51-1.07)	1.17 (0.86-1.59)	0.85 (0.65-1.13)

Note: All analyses mutually adjusted for sex, age-group, educational level, occupational group and wave of COVID-19. Clustered risk and frequent personal health anxiety were additionally adjusted for baseline of perceived health. Time in mentally passive and active sitting, as well as when socializing, were additionally adjusted for baseline level of total sedentary behaviour.

3.4 Type of sitting and change in lifestyle habits in relation to mental ill-health

A negative perceived change in each lifestyle habit, compared to no or positive change, was associated with higher odds for clustered mental ill-health (Figure 2). This was seen for all separate mental ill-health variables, except that it was not observed for perceived change in smoking.

More time spent in mentally passive sitting (Tertile 3; ≥ 120 min/day vs. Tertile 1; 0 to 90 min/day) was associated with higher odds for all variables and clustering of mental ill-health (Table 4). No similar associations were seen for more time spent in mentally active sitting or time in sitting socializing.

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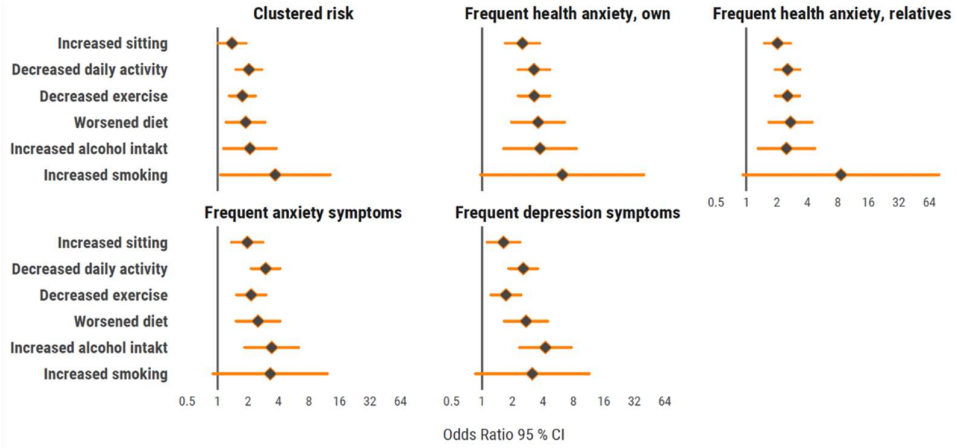

Figure 2. Forrest plot with OR (95% CI) for clustering of mental ill-health variables in relation to change in lifestyle habits. All analyses adjusted for sex, age-group, educational level, occupational group, wave of COVID-19 and baseline values for each lifestyle habit.

4. Discussion

In this large cohort of workers in Sweden, a country with relatively few social restrictions during the pandemic, we noted that there were overall small changes in the lifestyle variables studied over time during the COVID-19 pandemic in 2020. When changes were present, they were more pronounced during the first wave compared to the second. We also noted how the pandemic impacted some segments of the population more than others; women, individuals <60 years, having a university degree, being white-collar workers and having unhealthy lifestyle habits at baseline had higher odds of changing their lifestyle habits compared to their counterparts. Negative changes in lifestyle habits as well as more time spent in mentally passive sitting at home was associated with higher odds of mental ill-health.

4.1 Changes in lifestyle habits in Sweden compared to other countries

The results from this cohort of Swedish men and women differ from other countries, in that the majority maintained their lifestyle habits during the COVID-19 pandemic. However, these results are in line with a report in May 2020 from the Swedish National Board of Public Health, where a majority reported no change compared to before the COVID-19 pandemic, (total PA 60%, diet 71%, alcohol 79% and smoking 77%) [29]. The fact that such a large group did not perceive that they made a negative change to their lifestyle habits may have a positive impact on national public health over time. For example, the reported decrease in daily PA (26% first wave and 20% second wave) and exercise (28% and 21%) are noticeably lower than in a large Australian study where approximately 50% reported a decrease in PA [11]. A study exploring the number of daily steps worldwide during the first wave (March to June 2020), concluded that Swedish citizens maintained their number of daily steps to a higher degree in comparison to other countries, e.g. the maximal decrease of average step counts was 49% in Italy compared to 7% in Sweden [30]. These differences might be partly explained by differences in lock-down regulations, where Sweden implemented less harsh social restrictions with no lock-down. A study carried out in April 2020 from the US, where restrictions differed between states, showed significant changes in PA patterns in the states with the hardest restrictions (self-isolation) and no changes when restrictions were more modest (stay at home or physical distancing) [31].

The increase in sitting time (26% first wave and 17% second wave) is in line with other studies [1, 2, 5], and may be due to similar restrictions regarding work situations in these countries. We also included questions regarding time spent sitting at home in

mentally passive sitting, mentally active sitting and sitting during socialization, as previous research has indicated different relationships between these different types of sedentary behaviour and mental well-being. Hallgren et al showed that mentally active sitting was associated with a 29% lower risk for major depressive disorders after 13–years follow-up in middle-aged men and women, while mentally passive sitting was associated with a 26% higher risk [18]. A study comparing sitting at work (assumably predominantly mentally active sitting) and in leisure time (assumably predominantly mentally passive sitting) showed weak associations of sitting at work and frequent symptoms of anxiety and depression, while more time sitting during leisure time was associated with three to four times higher OR compared to less time sitting during leisure time [32]. This is comparable to the results in the present study, where more self-reported time in mentally passive sitting (<120 min/day) compared to less (0 to 90 min/day) was associated with ~60 to 100% higher risk (OR) for the different mental ill-health outcomes. No similar associations were found for mentally active sitting or time sitting while socializing. Although the directions of the associations observed is not clear, possible variation between different types of sitting and mental health outcomes should be considered in future studies on the impact of pandemic restrictions, as well as in interventions targeting sitting for mental health outcomes.

For changes in sitting time, daily PA, and exercise, it was more evident that individuals with low PA levels at baseline had higher odds of a negatively perceived change in PA due to the pandemic. This is similar to a previous study by Lesser et al, which concluded that individuals regularly active before the pandemic increased their PA, whereas inactive individuals became even less physically active [17]. On the contrary, a Canadian study showed that previously active adults decreased their PA, while previously inactive adults did not change their PA due to the pandemic [31]. In contrast to other studies, women in the present study had a 36-38% higher risk of decreasing their daily PA and exercise level compared to men. There were also differences between occupational groups, where white-collar workers had higher odds of increasing daily PA, exercise, and decreased sedentary time, compared to blue-collar workers. Differences in lifestyle changes due to COVID-19 in relation to occupation groups have not been studied in previous studies.

There were small changes in diet, alcohol, and smoking habits in the present study, which is in line with other studies. However, the results showed that there were differences between and within the sociodemographic subgroups. For example, individuals with healthy diets had an approximately 80% lower risk of their dietary habits deteriorating compared to individuals with poor dietary habits. Moreover, white-collar workers were more prone to changing their diet in either direction, and had approximately 90% higher probability of worsening as well as improving their dietary habits compared to blue-collar workers. This might be due to blue-collar workers having to be at their workplaces to a higher extent, which probably contributed to fewer possibilities to change their behaviour compared to white-collar workers who were able to work more from home. The large differences between blue- and white-collar workers working from home or not are similar to a report from Swedish statistics. The report concluded that while 56% of individuals with a university degree or equivalent reported that they did not work from home at all, the corresponding number among individuals with occupations requiring shorter education or introduction was 97%. [33]. To our knowledge, there are no previous studies exploring differences between white- and blue-collar workers, which seems to be an important factor for the association of changes in lifestyle habits during the COVID-19 pandemic. In this study, young individuals had higher odds of both an increase and decrease in alcohol intake, with women having a lower probability of decreasing their alcohol intake. Moreover, a Canadian study concluded that younger individuals and individuals with higher educational levels had higher risks of increasing their alcohol intake compared to older individuals and those with a lower education level [9]. Our results indicated that daily smokers had a 53% higher

risk of increasing their smoking compared to occasionally smokers, which is in line with a small Italian study [13]. However, in a study of > 20,000 men and women over 16 years of age, Jackson et al found that smokers in England were more likely to report trying to quit smoking, and rates of smoking cessation were higher than before lockdown [34].

In general, perceived changes in lifestyle habits were seen during both the first and second COVID-19 pandemic waves in Swedish workers. However, during the second wave, fewer individuals reported a change in lifestyle habits. This might be due to temporal effects, meaning that changes in lifestyle habits during the first wave have become the "new normal" of lifestyle habits.

4.2 Changes in mental health in Sweden compared to other countries

We found relatively low prevalence of mental ill-health, with 4 to 6% scoring high on health anxiety regarding their own health, generalized anxiety and depression symptoms as well as concerns regarding employment and economy. Only health anxiety for relatives was more prevalent (12%). The health anxiety for one's own health is similar to the report from the Swedish National Board of Public Health in May 2020, where 5% were very worried about their own health, with a higher frequency for health anxiety for relatives health (25%) [29]. However, in general it is lower in comparison to reports from the UK, where 37% experienced poor mental well-being [35]. We found that women, participants <60 years and those with a perceived negative change in daily PA, sitting time, exercise, diet and alcohol consumption, were more vulnerable to mental ill-health. The non-significant association between smoking and mental health, is probably due to power issues, as there were few daily smokers. The higher odds of mental ill-health in women and younger age groups have been reported in previous studies [15, 35]. The association between mental health and lifestyle habits e.g. PA [1-3, 31], alcohol consumption [11, 12], diet [11] and smoking habits [11] has also been shown in previous studies, with more unhealthy behaviour being shown to be associated with poorer mental health. This indicates that interventions for improving mental health in society should target women, younger individuals and those with unhealthy or negative changes in important lifestyle habits. Interestingly, in this study the higher odds for women and younger individuals was also seen for health concerns for their relatives, which has not been studied previously.

In summary, it is important to be aware of the risk of a perceived negative change of lifestyle habits during the COVID-19 pandemic. In this study, there was an association between a perceived negative change of lifestyle habits and a higher risk of mental ill-health. Moreover, it is well known that healthy lifestyle habits are important in order to prevent non-communicable diseases [36, 37]. This emphasizes the need to support individuals to improve or maintain healthy lifestyle habits during the COVID-19 pandemic in order to prevent health inequalities in society and promote national public health.

4.3 Strengths and limitations

A strength of this study is the reasonably large cohort of women and men of different ages, with a variation in educational level and occupation. The extended period of data collection (from April to December) enables unique comparative analyses between the two waves of the COVID-19 pandemic in perceived changes in lifestyle habits in the total study population as well as in sub-groups, and its association to mental health. Another strength is that the study explores different components of the PA pattern, including both sitting, daily PA, and exercise, as well as different aspects of mental health (clustered mental ill-health, anxiety concern, generalized anxiety, and depression). A limitation is the cross-sectional design, which decreases the ability to draw conclusions of causality and temporal order. Also, we examined self-reported perceived changes in lifestyle, which is not the same as within-person change based on multiple measurements. The study population consists of individuals who accepted to answer the extra covid-19

related questions, which poses a risk of selection bias. Another limitation is that lifestyle habits and changes in lifestyle habits are based on questionnaires not validated in previous work, thus risking recall bias [38]. However, questionnaires with categorical answer modes, as used in the present study, provide better validity compared to open answers for level of PA [39].

5. Conclusions

Our findings suggest only small perceived changes in lifestyle habits, including sitting, daily PA, exercise, diet, alcohol and smoking in men and women from the Swedish working population in relation to the two COVID-19 pandemic waves. Both negative and positive changes were more pronounced during the first wave compared to the second. Changes varied between sociodemographic groups, suggesting a clear divergence in how the pandemic waves have impacted both individuals and society. Individuals with an unhealthy lifestyle at baseline were more likely to change their lifestyle habits negatively. Furthermore, negative changes in lifestyle habits tended to be associated with higher levels of mental ill-health. The perceived negative changes in health-related lifestyles is a considerable public health concern, with clear implications for further increases in health inequality, mental health challenges, and other non-communicable diseases. To strengthen the resilience of both society and individuals to future viral pandemics, there is a clear need to focus on the promotion of healthy lifestyle habits, especially in socially vulnerable groups.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets generated and/or analyzed during the current study are not publicly available due being property of HPI Health Profile Institute, but are available from the corresponding author or the HPI Health Profile Institute on support@hpihealth.se.

Conflicts of Interest: Gunnar Andersson (responsible for research and method) and Peter Wallin (CEO and responsible for research and method) are employed at HPI Health Profile Institute.

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